

Philosophy 1103: Introduction to Philosophy of Science

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Solutions to Practice Quiz 3

Total: 40 marks

1. In *Starry Messenger*, published in 1610, Galileo described his observations of the moon as follows:

... the Moon is by no means endowed with a smooth and polished surface, but is rough and uneven and, just as the face of the Earth itself, crowded everywhere with vast prominences, deep chasms, and convolutions.

- (i) Does this observation seem to agree with Aristotelian physics? Explain your answer. [2 marks]

No. Aristotelian physics says that all celestial bodies are perfect spheres made of aether. There should be no bumps.

- (ii) With reference to the ‘Duhem problem’, explain in general terms why an Aristotelian need not accept that Galileo’s observation *falsifies* Aristotelian physics. [2 marks]

Duhem said that it’s always possible to keep a theory like Aristotelian physics, but alter some ‘auxiliary hypothesis’ to make the data fit it.

Ludovico delle Colombe was an Aristotelian philosopher who responded to Galileo by stating that the moon is a smooth sphere of transparent aether encasing a rough and uneven core of opaque aether, like “a big ball of the clearest crystal, inside of which a little earth is formed out of white enamel.” Because the transparent outer layer is completely invisible to us, the moon appears “unequal, toothed, and mountainous, even if it is not.”

- (iii) Thus, according to delle Colombe, Galileo’s argument against Aristotle requires an auxiliary assumption. What is that assumption? [2 marks]

Galileo is assuming that, according to Aristotle’s theory, the moon would be made entirely of opaque ether, with no transparent aether.

Galileo was not impressed with delle Colombe's response, and replied to him as follows:

Truly the imagination is beautiful; its only lack is that it is neither demonstrated nor demonstrable. And who does not see that this is a pure and arbitrary fiction, that puts nothing in being, and only offers something simply non-repugnant [to the theory]....I would voluntarily concede [Delle Colombe's invisible crystal sphere], if only that, with equal courtesy, I would be permitted to say that this crystal has on its surface a very large number of immense mountains, thirty times larger than the earth's, which, since they are of a diaphanous substance, cannot be seen by us; and thus I would draw another Moon ten times more mountainous than the first. And who will want to judge my assumption chimerical, without condemning by the same token the position of the adversary?

- (iv) Galileo's reply here seems to agree with Karl Popper's (much later) criterion for a theory to be scientific. Briefly state this criterion, and explain why delle Colombe's theory of an invisible crystal sphere fails to satisfy it. [3 marks]

Popper said that a scientific theory must be empirically falsifiable, which requires it to make predictions. But delle Colombe's invisible crystal is impossible to observe, so it can't be falsified.

2. Read the following passage, and answer the questions below it.

One notable event during the Covid-19 pandemic was the absence of a 2020-2021 flu season. The United States, for example, saw about 700 deaths from influenza during the 2020–2021 season, compared to 22,000 U.S. deaths in the prior season and 34,000 deaths two seasons ago.

What could be the reason for this? Many experts say that the sharp drop in flu cases was mostly due to mask-wearing and lockdowns. Even though these measures had little impact on the spread of Covid, they seem to have been effective against flu, which is much less infectious than the SARS-CoV-2 virus.

Others have questioned this hypothesis, pointing out that in Japan and some other parts of Asia it has long been customary for people to wear masks when sick, without any obvious impact on their flu seasons. Also, in the USA, masking has been found to be ineffective against the spread of flu in previous flu pandemics. Further, Sweden had almost no 2020-21 flu season, despite few Swedish people wearing face masks and many schools and businesses remaining open.

A second hypothesis is that there were just as many flu cases as usual during the 2020-21 flu season, but most of these cases were falsely registered as Covid cases. The symptoms of flu are similar to those of Covid, and hospitals in the USA were financially rewarded for treating Covid patients – getting a special payment of \$13,000 for each one. No doubt they were anxious to have as many “Covid” patients as possible! The problem with this theory is that the flu disappeared also in countries, like Sweden, that lacked such incentives to exaggerate Covid numbers. Sweden for example tested 175,000 patients for the flu, which is much higher than usual, but only 29 of these tests were positive.

A third hypothesis is that flu cases were suppressed by the SARS-2 coronavirus itself, since being infected with one virus will often give a person resistance to a second virus – a phenomenon known as ‘viral interference’. The 2009 swine flu virus temporarily displaced previous flu viruses in this way, and more transmissible SARS-2 strains have repeatedly displaced previous coronavirus strains.

(i) Summarise the relevant *data* mentioned in the passage above. (There are about eight data mentioned in the text.) [3 marks]

1. Flu disappeared in the USA and around the world in 2020-21.
2. Masks for flu haven't worked previously in the USA or Japan.
3. In 2020-21 Sweden tested for flu, but found very few cases.
4. Sweden didn't lock down too much, or wear many masks.
5. Viruses have been found to displace each other.

(ii) Briefly describe the three *hypotheses* mentioned that were used to explain these data. [3 marks]

1. Masks and lockdowns suppressed the flu season.
2. Flu cases were common as usual, but misidentified as Covid cases.
3. The flu was suppressed by Covid, through viral interference.

(iii) How plausible was each theory? (Point out any aspects that seem inherently plausible/implausible to you) [2 marks]

The level of fraud needed to register so many false Covid cases perhaps seems implausible. The others seem plausible.

(iv) How well did each theory predict the data, overall? Explain your answers. [3 marks]

The mask/lockdown theory fails to predict the absence of flu cases in Sweden.

The fraud theory fails to explain the negative flu tests in Sweden.

The viral interference theory accounts for all the data.

- (v) Comment on the overall strength of each hypothesis. Is there a clear winner?
[3 marks]

Since the viral interference theory predicts the data, and is reasonably plausible, it is the best explanation.

3. Match each statement about scientific reasoning to the philosopher who said it.
(Choose from: Francis Bacon, Gottfried Leibniz, David Hume, Karl Popper.)
[1 mark each]

Leibniz “Although the senses are necessary for all our actual knowledge, they aren’t sufficient to provide it all ... and so the proof of [necessary truths] can only come from inner principles, which are described as innate.”

Popper “I hold that neither animals nor men use any procedure like induction ... The answer to this problem [of induction] is ... we are justified in reasoning from a counterinstance to the falsity of the corresponding universal law.”

Hume [scientific conclusions] “are not based on reasoning or on any process of the understanding. ... These operations of the soul are a kind of natural instinct, which no reasoning or process of the thought and understanding can either produce or prevent.”

Bacon “I must lead you to the particular events themselves, and to the order in which they occur; and you for your part must force yourself for a while to lay aside your notions and start to familiarize yourself with facts.”

4. According to Karl Popper’s criterion of what makes a theory scientific, is the Copernican model more scientific than the Ptolemaic model? Explain your answer.
[3 marks]

According to Popper’s falsifiability criterion, the Ptolemaic model is certainly falsifiable since it was actually falsified by observation of the phases of Venus! (N.B. While the specific Ptolemaic model is just as falsifiable as the Copernican model, the general idea of epicycles isn’t very falsifiable as it’s so flexible.)

5. Summarise Leibniz's argument for his view that scientific knowledge requires more than just empirical data. [3 marks]

Scientific knowledge includes knowledge of universal laws, which give us information about events that have never been observed. (Clearly, however, observations alone cannot tell us about unobserved events!) So we must have extra information that is not from experience.

6. One response to Hume's problem of induction is to say that science uses 'inference to the best explanation', or IBE. Briefly describe how IBE works, and explain why IBE seems to require that some general principles are known innately, prior to experience. [3 marks]

IBE measures the 'strength' of a hypothesis H , as an explanation of evidence E , according to H 's plausibility (given background knowledge, but not using E) and the degree to which H predicts E . Then if we let E be our total empirical data, we still need to assess the inherent plausibility of H , but this cannot depend on any empirical data at all.

7. Karl Popper believed that scientific hypotheses are never 'confirmed' by empirical evidence.

- (i) Explain what this claim means, in ordinary language. [2 marks]

Scientific theories are never supported by empirical evidence, i.e. they are never reasonable to believe (to a significant degree) on the basis of that evidence.

- (ii) State one argument against this claim. [2 marks]

In many situations we 'bet on' scientific theories, i.e. we do something that will be very costly if the theory is false. Such bets are always irrational according to Popper's claim.